



Candidate Code No.	
For Board Use Only	
Result	Result
Date	Date
Int	Int

ELECTRICIANS REGULATIONS EXAMINATION

28 June 2014

QUESTION AND ANSWER BOOKLET

Time Allowed: Three hours

INSTRUCTIONS – READ CAREFULLY

You have 10 minutes to read this paper but do not start writing until you are told to do so by the supervisor.

Write your Candidate Code Number in the box provided above. Your name must NOT appear anywhere in this paper.

Answer all questions.

The pass mark for this examination is 60 marks.

Use a pen for written answers. **Do not** use pencils or red pens.

Drawing instruments and pencils may be used when diagrams are required. Marks are allocated on the basis of correctness.

Do not use correcting fluid or correcting tape.

It is recommended that the reference source for your answers be included in the space provided if a question can be answered from the Act, Regulations, Standard or Code of Practice. However, just stating a reference only will earn no marks.

For calculation questions all workings, including formulae, must be shown to gain full marks.

Warning – You could get 0 marks for any question, or part of a question, if you show anything hazardous or dangerous in your answer.

You will need to use the following documents in this examination:

- Electricity (Safety) Regulations 2010 reprint dated 1 February 2014
- AS/NZS 3000:2007 and Amendments 1 and 2

PLEASE HAND THIS PAPER TO THE SUPERVISOR BEFORE LEAVING THE ROOM

(turn over)

Question 1

- (a) Refer to the Electricity (Safety) Regulations 2010 and state the **TWO** situations where **low voltage fittings** are deemed to be electrically unsafe. (2 marks)

(1) _____

(2) _____

Ref:

- (b) Additions and alterations have been completed to an existing low voltage electrical installation. The installation is to be connected to the electricity supply and an electrical safety certificate issued.

Refer to the Electricity (Safety) Regulations 2010 and state the requirements relating to the electrical safety certificate when a **trainee** connects the installation.

(2 marks)

Ref:

(turn over)

Question 1 continued

- (c) Refer to AS/NZS 3000 and state the circumstances where the protection disconnection time for a circuit can be greater than 0.4 seconds but must not exceed 5 seconds.

(2 marks)

Ref:

- (d) AS/NZS 3000 sets **TWO** basic requirements for an **electrical installation circuit arrangement**. Refer to AS/NZS 3000 and state those requirements.

(2 marks)

(1)

(2)

Ref:

(turn over)

Question 1 continued

- (e) One of the **general** requirements for electrical equipment used in damp situations is that it shall be selected and installed to **operate safely near or within a damp or wet environment**.

Refer to AS/NZS 3000 and state the **TWO** other requirements relating to selecting and installing electrical equipment in damp situations.

(2 marks)

(1) _____

(2) _____

Ref:

- (f) Refer to AS/NZS 3000 and state **ONE** safety requirement for the prevention of injury to persons or damage to property that must be met in the event of complete power failure to an electric motor.

(2 marks)

Ref:

(turn over)

Question 1 continued

- (g) Refer to AS/NZS 3000 and state the **TWO** requirements for the identification of equipment on a switchboard.

(2 marks)

(1) _____

(2) _____

Ref:

- (h) Refer to AS/NZS 3000 and state **TWO** types of pipes that **shall not** be used for a main earthing conductor or a protective earthing conductor.

(2 marks)

(1) _____

(2) _____

Ref:

(turn over)

Question 1 continued

- (i) Refer to AS/NZS 3000 and state the precautions to be taken when testing a low voltage electrical installation.

(2 marks)

Ref:

- (j) Alterations and additions have been carried out on an existing low voltage electrical installation.

Refer to AS/NZS 3000 and state what needs to be verified in respect to those alterations and additions.

(2 marks)

Ref:

(turn over)

Question 2

- (a) Fittings **are installed** in an electrical installation.

Refer to the Electricity (Safety) Regulations and state **ONE** situation where **fittings that are installed** in an installation are **specifically** deemed to be electrically unsafe.

(1 mark)

Ref:

- (b) Refer to AS/NZS 3000 and state the **TWO** requirements relating to the installation of an over temperature cut-out for an **unvented water heater**.

(2 marks)

(1)

(2)

Ref:

(turn over)

Question 2 continued

- (c) Refer to AS/NZS 3000 and state the **TWO** requirements for the **switching** of a **stationary** cooking appliance that incorporates an open cooking surface for both gas and electric cooking.

(2 marks)

(1) _____

(2) _____

Ref:

- (d) Refer to AS/NZS 3000 and state the connection requirements for a **free-standing** cooking appliance.

(1 mark)

Ref:

(turn over)

Question 2 continued

- (e) Refer to AS/NZS 3000 and state the **FOUR** methods of connecting electrical equipment in a low voltage electrical installation.

(2 marks)

- (1) _____

- (2) _____

- (3) _____

- (4) _____

Ref:

- (f) Refer to AS/NZS 3000 and state the **TWO current rating** requirements, either of which applies to a **switch that controls two socket outlets**.

(2 marks)

- (1) _____

- (2) _____

(turn over)

Question 3

Introduction

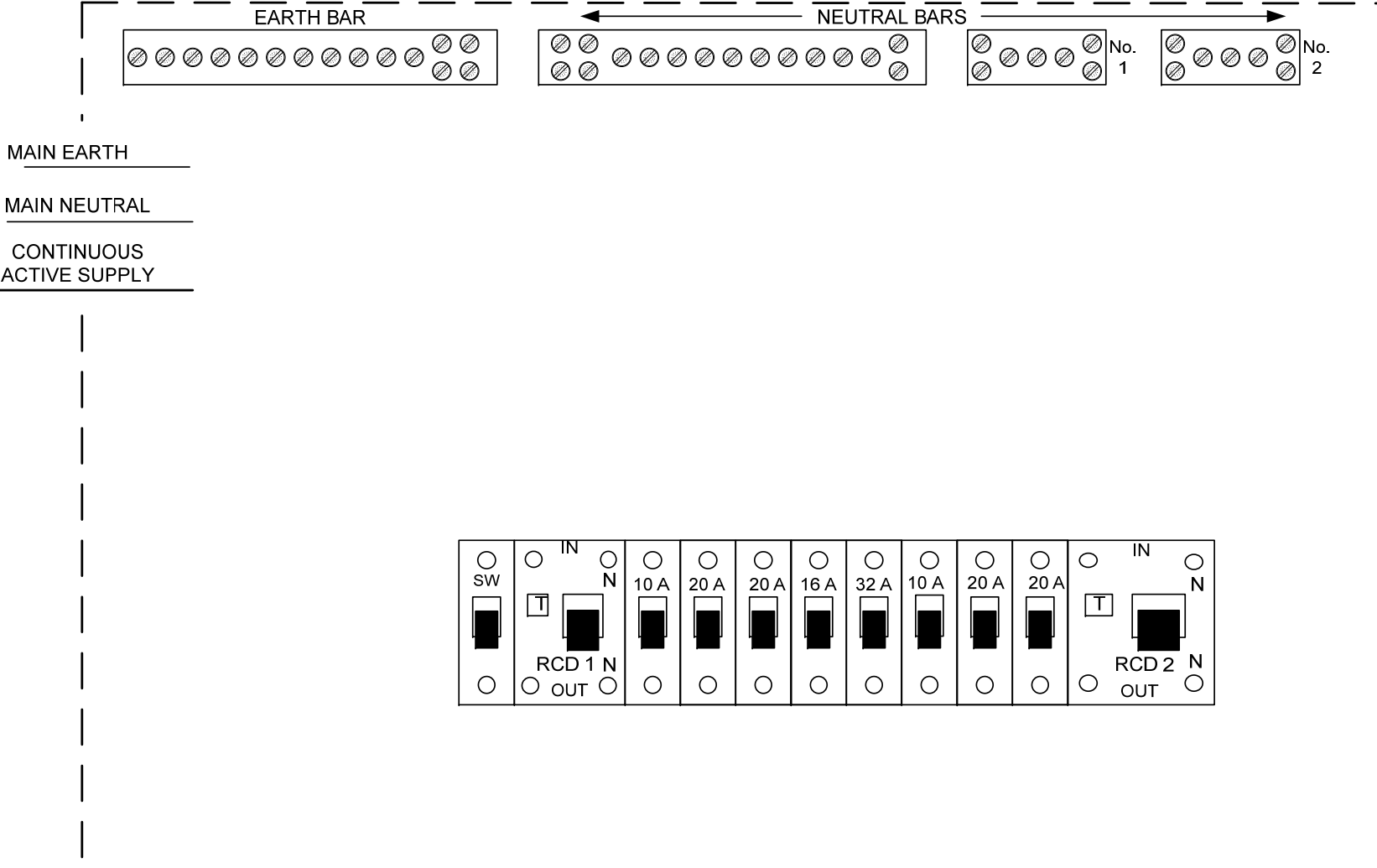
A new MEN switchboard has been installed in a domestic electrical installation.

The figure on the next page shows the switchboard with:

- 1 Main earth bar
- 1 Main neutral bar
- 2 Neutral bars (No.1 and No. 2)
- 1 63A main switch
- 2 RCDs – protecting relevant final subcircuits.
- 4 20A MCBs – protecting socket outlet final subcircuits
- 2 10A MCBs - protecting lighting final subcircuits
- 1 16A MCB – protecting a permanently connected water heater final subcircuit
- 1 32A MCB - protecting a range final subcircuit

(turn over)

Question 3 continued



Use the information in the introduction to this question to answer parts 3(a), 3(b), 3(c) and 3(d)

(turn over)

Question 3 continued

- (a) Refer to AS/NZS 3000 and state the circumstances under which the switchboard in the introduction can be installed in an area that may be affected by water splashing or steam

(1 mark)

Ref:

- (b) On the switchboard in the introduction, draw the conductors that need to be installed **before** the incoming cable conductors are terminated.

(5½ marks)

- (c) On the switchboard in the introduction, terminate:

- The main earth
- The main neutral
- The continuous (active) supply

(1½ marks)

(turn over)

Question 3 continued

- (d) Refer to AS/NZS 3000 and state why the switchboard meets the **RCD requirements** of that Standard. State references to support your answer.
(2 marks)

Ref:

(turn over)

Question 4

- (a) Refer to AS/NZS 3000 and state **TWO selection and installation** requirements for the earthing arrangements for an electrical installation.
(2 marks)

(1) _____

(2) _____

Ref:

- (b) Refer to Clause 5.2.1 of AS/NZS 3000 and explain the main purpose of a **protective earthing system**.
(2 marks)

Ref:

(turn over)

Question 4 continued

- (c) (i) Refer to Clause 5.2.2 of AS/NZS 3000 and explain the main purpose of a **functional earthing (FE) system**.

(1 mark)

- (ii) Refer to Clause 5.2.2 of AS/NZS 3000 and state the colour coding requirements for a **functional earthing conductor**.

(1 mark)

Ref:

- (d) Earthing conductors are generally copper or aluminium.

Refer to AS/NZS 3000 and state the **TWO** requirements for the use of other materials (not copper or aluminium) as earthing conductors.

(2 marks)

(1)

(2)

Ref:

(turn over)

Question 4 continued

- (e) Refer to AS/NZS 3000 and state **FOUR** requirements for using a catenary wire as a protective earthing conductor.

(2 marks)

- (1) _____

- (2) _____

- (3) _____

- (4) _____

Ref:

(turn over)

Question 5

Refer to AS/NZS 3000 and calculate the maximum demand **in amps** of a 230V single domestic installation with the following loads:

- 16 60W lights
- 17 100W lights
- 6 Metres of lighting track
- 3kW outside lighting
- 15 10A double socket outlets
- 2 10A single outside socket outlets
- 10 10A single socket outlets
- 1 12 kW electric range
- 1 3kW input air conditioner
- 1 4 kW instantaneous water heater

The **internal** lighting is to be calculated on a **points basis**.

Use the table on the following page for your calculations

(10 marks)

(turn over)

Question 5 continued

Equipment	Load Group	Calculation	Load (Amps)	
60W lights				
100W lights				
6 metres of lighting track				
3000W outside lights				
15 10A double socket outlets				
10 10A single socket outlets				
2 10A single socket outlets				
12kW range				
3KW air conditioner				
4KW instantaneous water heater				
Total Maximum Demand				

Ref:

(turn over)

Question 6

- (a) Refer to AS/NZS 3000 and state **TWO** reasons why testing the polarity of mains cables is necessary:

(2 marks)

(1) _____

(2) _____

Ref:

- (b) You have to carry out a test on a **live** single-phase, low voltage electrical installation to confirm whether or not a phase/neutral transposition has taken place on the mains.

- (i) List the equipment you would use to carry out a test to confirm whether or not a phase/neutral transposition has taken place on the mains.

(1½ marks)

(turn over)

Question 6 continued

- (ii) Describe how you would carry out a test to confirm whether or not a phase/neutral transposition has taken place on the mains – using the equipment stated in 6(b)(i).

(2½ marks)

- (iii) If **a transposition has taken place**

State the expected instrument readings from the tests you have carried out in 6(b)(ii) using the equipment stated in 6(b)(i).

(2 marks)

(turn over)

Question 6 continued

(iv) if **no transposition has taken place**

State the expected instrument readings from the tests you have carried out in 6(b)(ii) using the equipment stated in 6(b)(i).

(2 marks)

(turn over)

Question 7

(a) AS/NZS 3000 requires that RCDs protecting final subcircuits be tested.

- (i) Refer AS/NZS 3000 and state what is being verified when an RCD is being tested.

(1 mark)

Ref:

- (ii) Refer AS/NZS 3000 and state **THREE** methods that can be used to verify the function of an RCD.

(3 marks)

(1)

(2)

(3)

Ref:

(turn over)

Question 7 continued

- (b) An electrician has carried out an **insulation resistance test procedure** in a newly wired, three-phase, 400V/230V volt cowshed that includes two, 3 kilowatt water heating cylinders.

All of the insulation resistance test results obtained by the electrician during the **insulation resistance test procedure** complied with AS/NZS 3000.

One of the test results was that the insulation resistance test with **everything in the shed connected** gave a reading of 0.5MΩ. Explain why the electrician connected the cowshed to the power supply.

(2 marks)

(turn over)

Question 7 continued

- (c) (i) Refer to AS/NZS 3000 and state the **principle** of protection by automatic disconnection of supply.

(2 marks)

- (ii) Refer to AS/NZS 3000 and state how the requirements of the principle of protection by automatic disconnection of supply stated in (c)(i) are met.

(2 marks)

(turn over)

Question 8

- (a) On a construction site only **230V, Class I, hand-held** electrical appliances are used.

The appliances are used in **indoor damp situations and outdoors**.

The construction-site foreman has asked you what the requirements are for the personal protection for his staff when they are using **these** electrical appliances.

- (i) Refer to the Electricity (Safety) Regulations 2010 and list **FOUR** protective systems that can be used to provide personal protection in the locations stated above.

(2 marks)

(1) _____

(2) _____

(3) _____

(4) _____

Ref:

(turn over)

Question 8 continued

- (ii) Select **TWO** of the protective systems you have stated in 8(a)(i) and describe how each provides personal protection to the user of a Class I electrical appliance on the construction site.

(4 marks)

(1) _____

(2) _____

- (iii) Refer to the Electricity (Safety) Regulations 2010 and state the maximum voltage permitted to be supplied by a single phase socket outlet complying with AS/NZS 3112 used to supply a hand-held portable appliance?

(1 mark)

Ref:

(turn over)

Question 8 continued

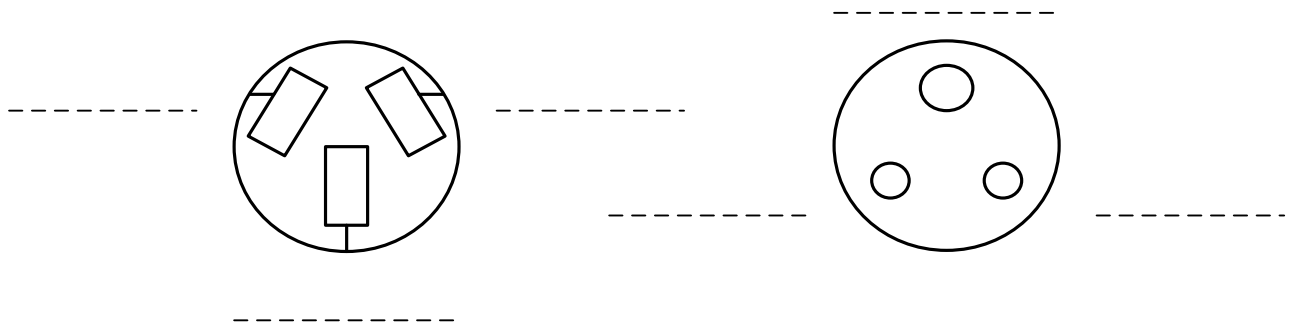
- (b) The two figures below show the **FACE VIEWS** of two single-phase socket outlets. Both socket outlets are connected to a standard low voltage supply.

Label the polarity of the socket outlets.

(3 marks)

AS/NZS 3112

IEC 60309



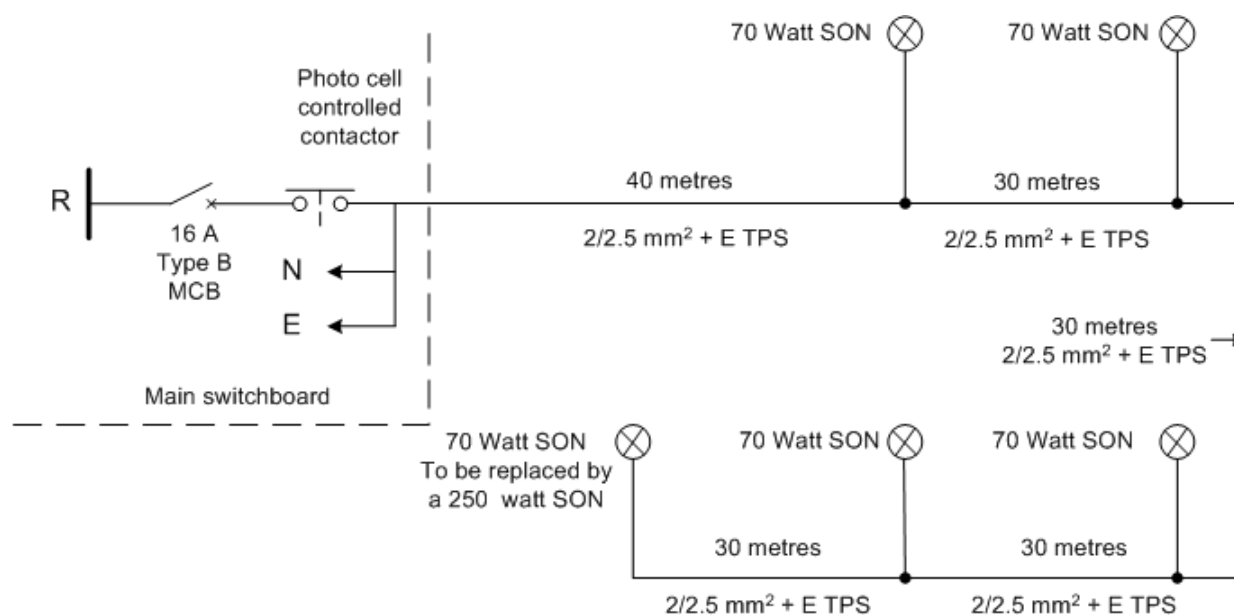
turn over)

Question 9

Introduction

This diagram shows the pole lighting of the driveway into a factory complex.

The factory three-phase 400/230V main switchboard is **directly connected** by consumers mains to the transformer terminals of the on-site substation transformer



Note: The cable route lengths allow for cabling to top of mounting poles

The 70W high pressure (SON) luminaire furthest from the main switchboard is to be replaced by a 250W SON luminaire.

- The maximum volt drop on the consumers mains under full load conditions is 2% of the **400V** supply voltage.
- The name plate of the 70W luminaire states the running current of the luminaire is 0.42A and the maximum current during starting is 0.63A
- The name plate of the 250W luminaire states the running current of the luminaire is 1.3 amps and the maximum current during starting is 1.9 amps.
- For correct starting, at least, 95% of the full supply voltage on of each of the SON luminaries is required.
- The **single-phase volt drop value** for a 2.5mm² cable is 18.02 mV/A.m

All the information needed to answer this question is contained in the introduction.

Use the information in the introduction to this question to answer parts 9(a), 9(b) and 9(c).

(turn over)

Question 9 continued

- (a) (i) Refer to AS/NZS 3000 and state the **maximum** voltage drop permitted **for this installation**. State a reference to support your answer.

(1 mark)

Ref:

- (ii) Calculate the **maximum** voltage drop – in volts - permitted in the cabling to the proposed 250 watt lamp position.

(2½ marks)

(turn over)

Question 9 continued

(b) Starting from the main switchboard the voltage drop:

- To the first luminaire is 3.19V (Vd1)
- Between the first and second luminaires is 2.05V (Vd 2)
- Between the second and third luminaires is 1.71V (Vd 3)

Calculate:

- The voltage drop between the third and fourth luminaires (Vd 4)
- The voltage drop between the fourth and the last (250W) luminaires (Vd 5)
- The maximum cable voltage drop to the proposed 250W luminaire position when all lamps are operating.

(5½ marks)

(c) From the answer in 9(b), state whether this installation meets the voltage drop requirements of AS/NZS 3000. Give a reason to support your answer.
(1 mark)

For Candidate's Use

In the box, write the number of **EXTRA** sheets you have used. Write **NIL** if you have not used any

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Questions Answered	Marks	
1		
2		
3		
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7		
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9		
TOTAL		